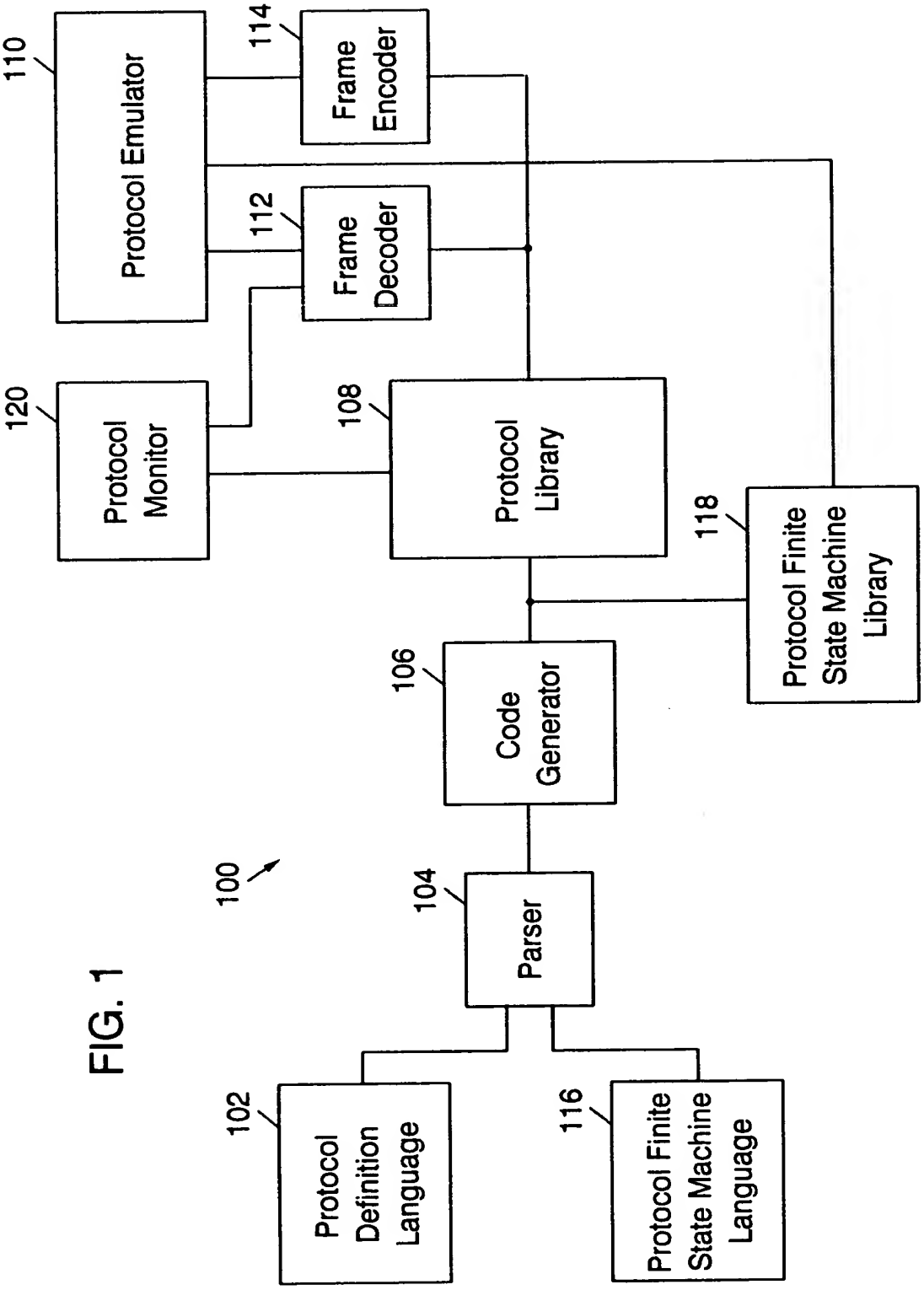
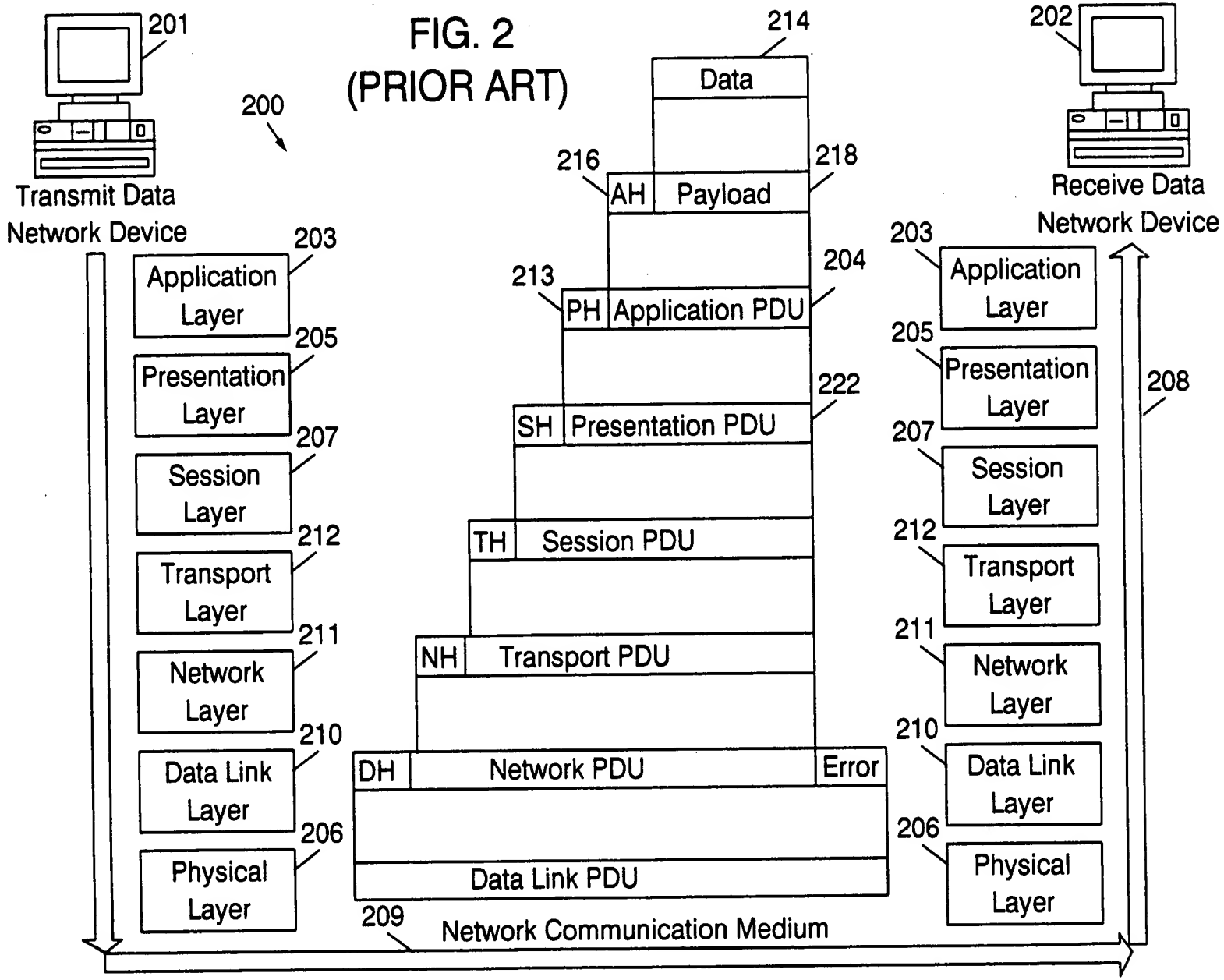

100
102
Protocol Definition Language
104
Parser
106
Code Generator
108
Protocol Library
110
Protocol Emulator
112
Frame Decoder
114
Frame Encoder
116
Protocol Finite State Machine Language
118
Protocol Finite State Machine Library
120
Protocol Monitor

FIG. 1

EH

FIG. 2
(PRIOR ART)



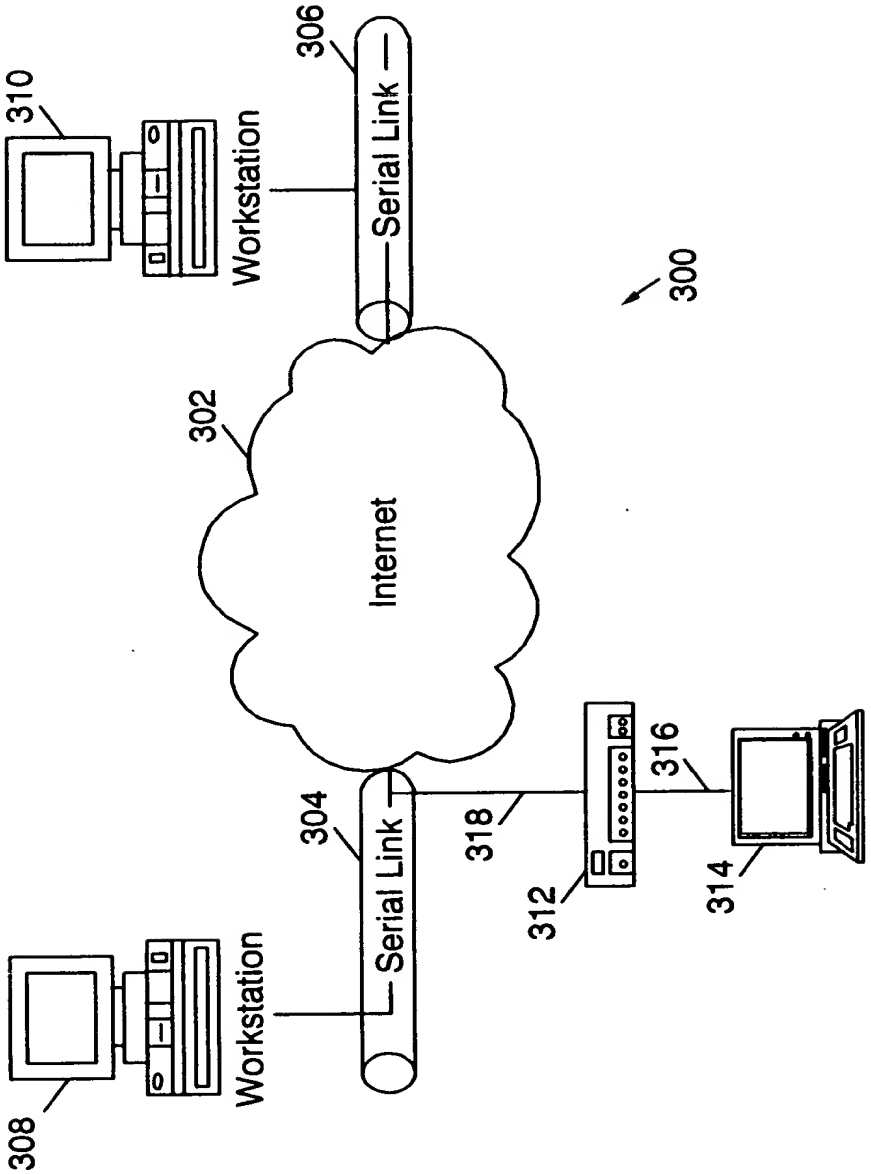
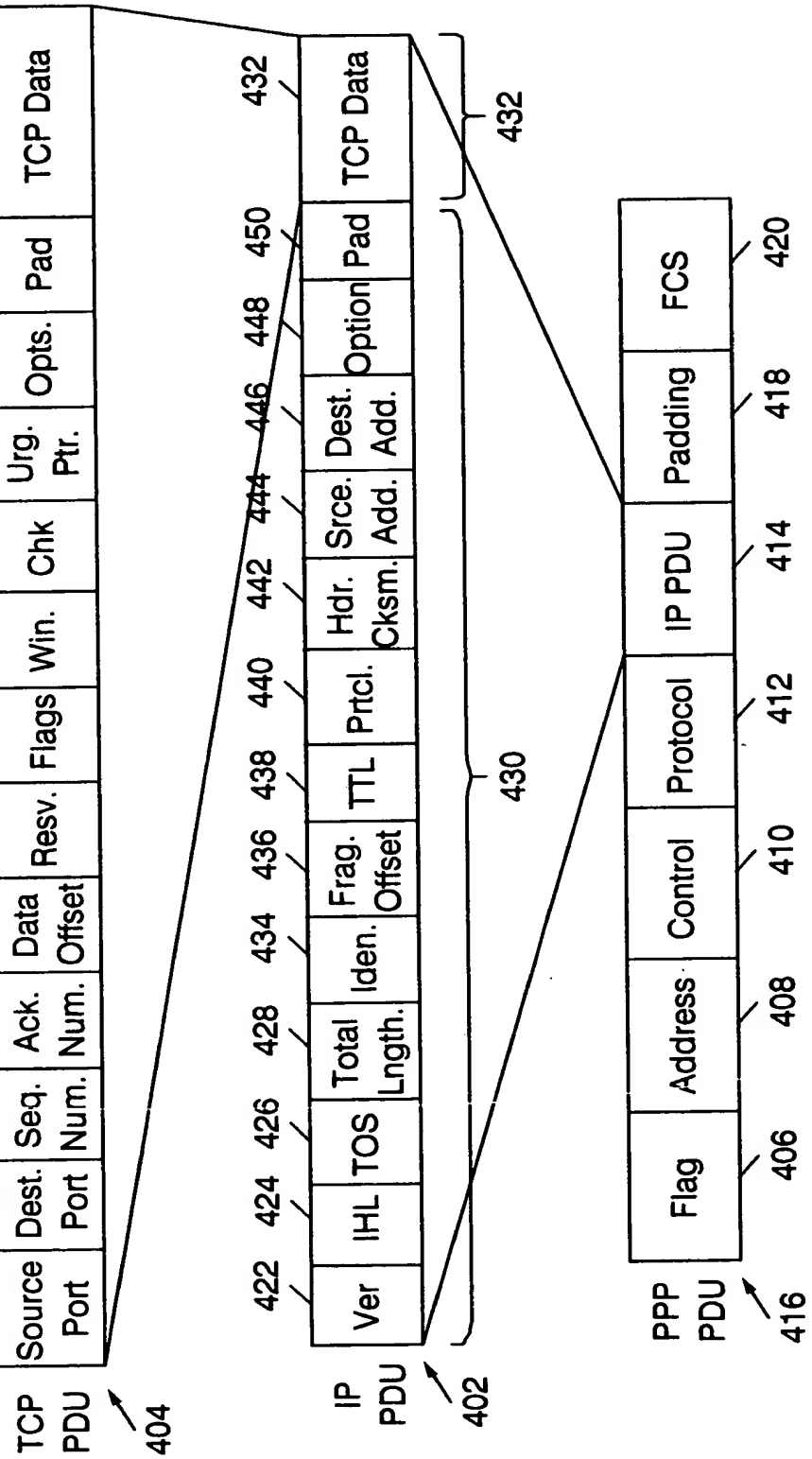


FIG. 3
(PRIOR ART)

FIG. 4
(PRIOR ART)



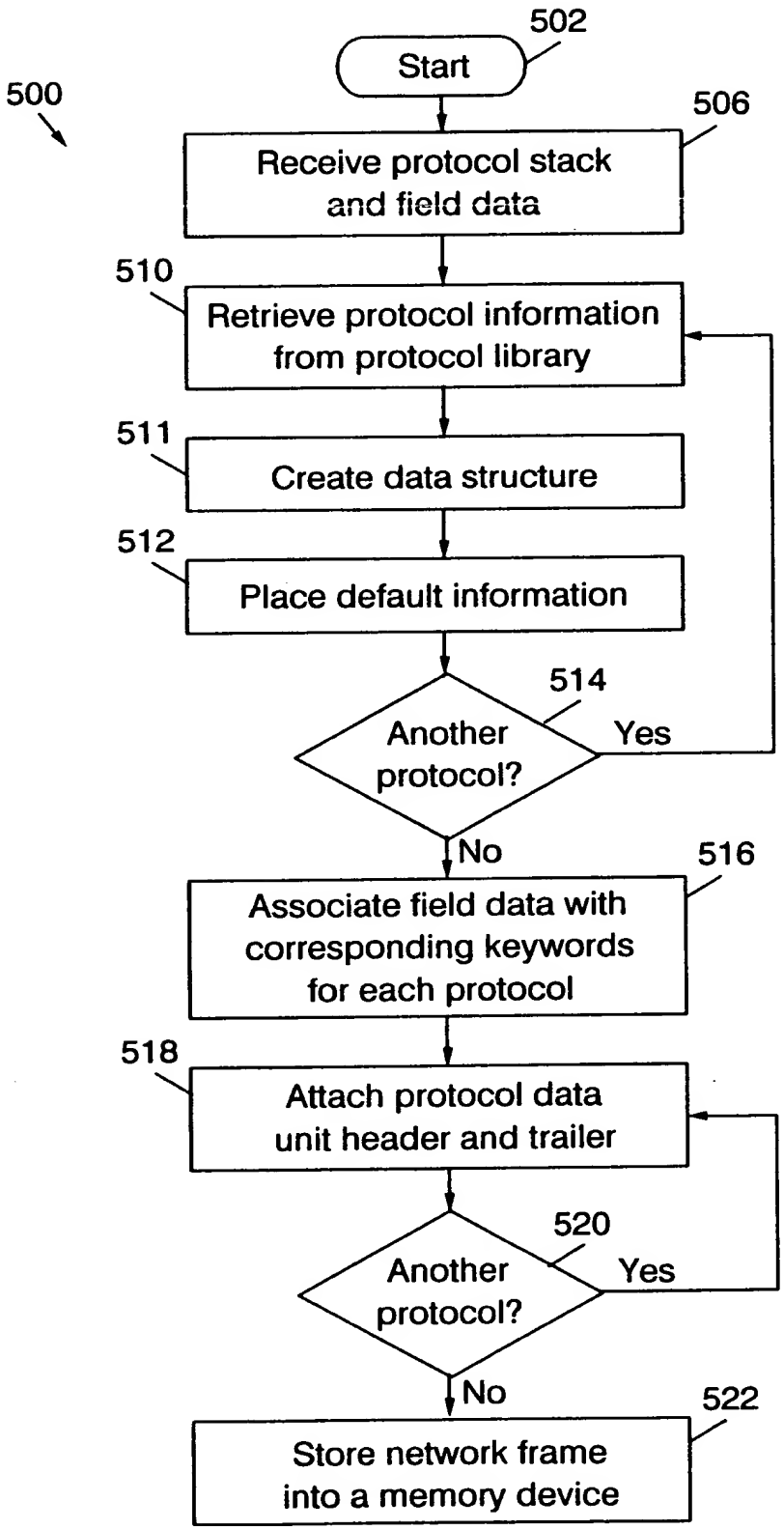

500
502
Start
506
Receive protocol stack and field data
510
Retrieve protocol information from protocol library
511
Create data structure
512
Place default information
514
Another protocol?
Yes
No
516
Associate field data with corresponding keywords for each protocol
518
Attach protocol data unit header and trailer
520
Another protocol?
Yes
No
522
Store network frame into a memory device

FIG. 5

FIG. 6

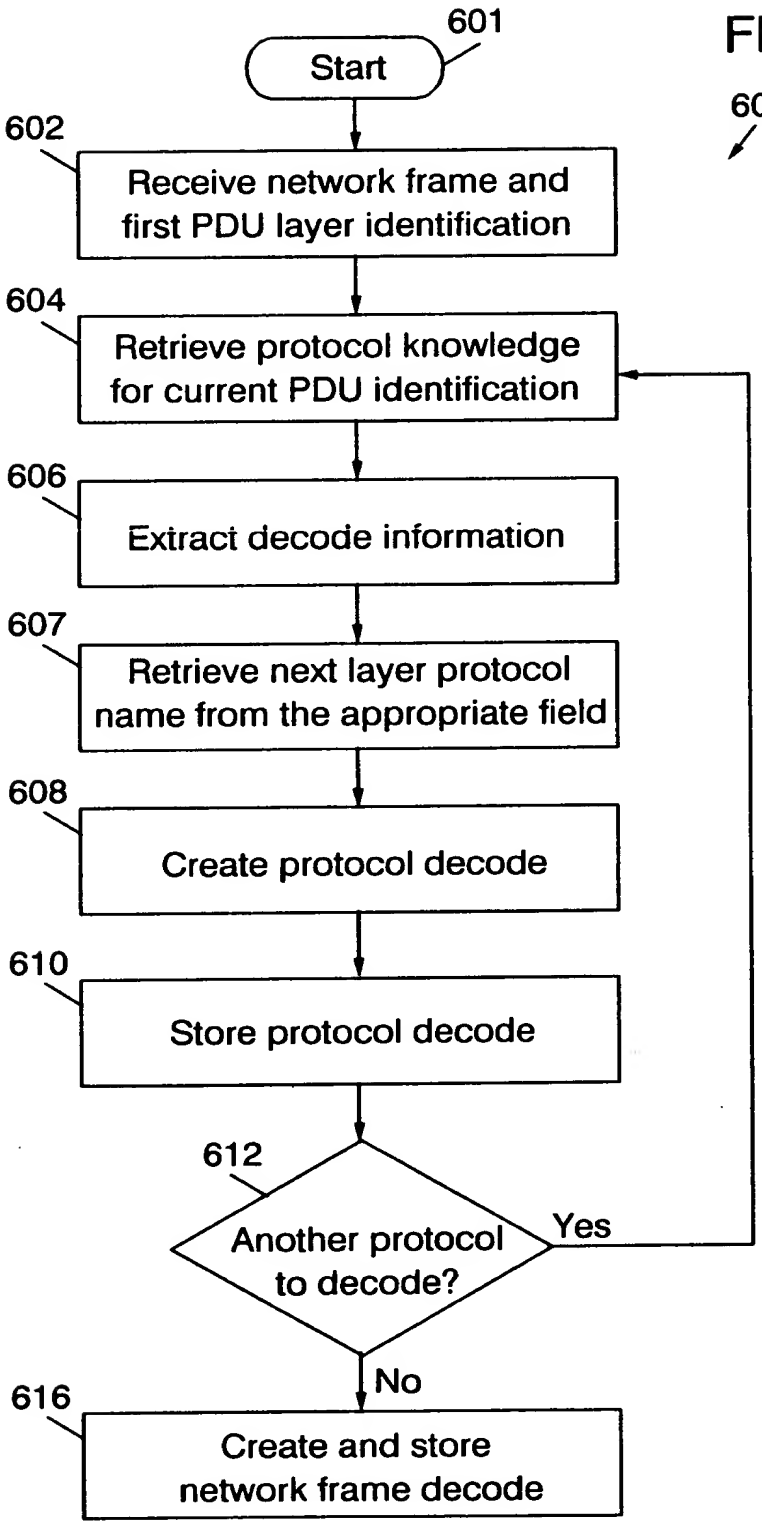

600
601
Start
602
Receive network frame and first PDU layer identification
604
Retrieve protocol knowledge for current PDU identification
606
Extract decode information
607
Retrieve next layer protocol name from the appropriate field
608
Create protocol decode
610
Store protocol decode
612
Another protocol to decode?
Yes
No
616
Create and store network frame decode

FIG. 7

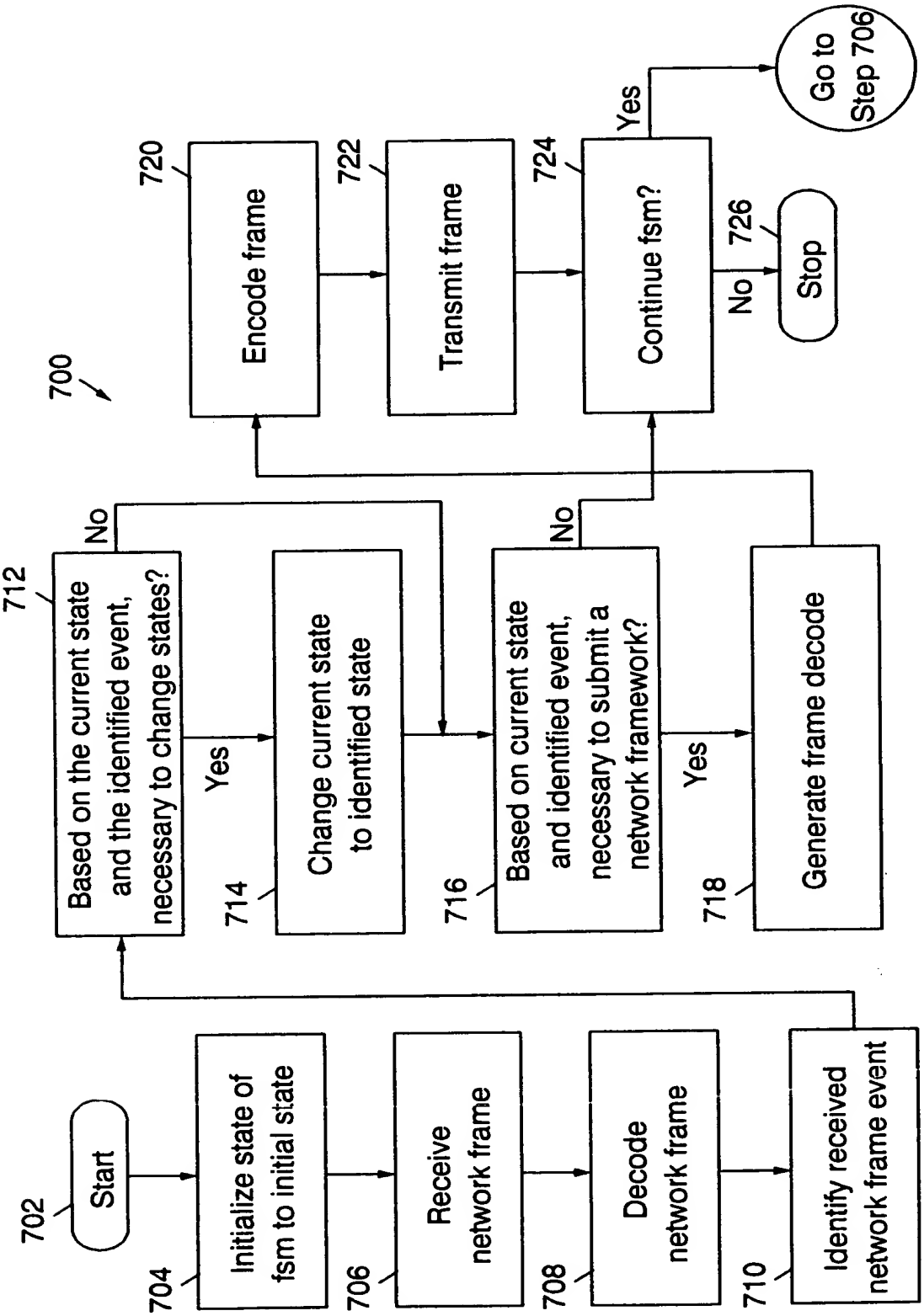

700
702
Start
704
Initialize state of fsm to initial state
706
Receive network frame
708
Decode network frame
710
Identify received network frame event
712
Based on the current state and the identified event, necessary to change states?
No
Yes
714
Change current state to identified state
716
Based on current state and identified event, necessary to submit a network framework?
No
Yes
718
Generate frame decode
720
Encode frame
722
Transmit frame
724
Continue fsm?
Yes
Go to Step 706
No
726
Stop

FIG. 8A

```
802
protocol "IP" {// - - - - - - - - - - - - - - - - - - - - - - -
        len=valueof(field "Total Length")*8
      minLen=20*8 //just header
  804 maxLen=65535*8
    header "IP Header"
806   payload "IP Payload"
  808
    header "IP Header" {// - - - - - - - - - - - - - - - - -
810
      len=valueof(field "Header Length")*32
  812 field "Version"          818
  816 field "Header Length"
      compound_field "Type Of Service"
  814 field "Total Length"
  824                                              820
    field "Identification" {len=16 default=291}
    compound_field "Flags"                                  822
815 field "Fragment Offset" {len=13 desc="in 64 bits units"}   826
    field "Time To Live" {len=8 default=30 desc="seconds"}
    field "Protocol"          830
828 field "Header Checksum"
    field "Source IP Address" {len=32 display=ipv4 field_type=
832         must_encode}
    field "Destination IP Address" {
834             len=32
                display=ipv4
                field_type = must_encode
        }
```

FIG. 8B

816

```
repeat {
    len=valueof(field "Header Length") - 5 )*32//includes padding
  compound_field "Options"
}

field "Version" {
            len=4
            default=4
            possible_values={
    0,15:"Reserved"
    1-3:"Unassigned"
            6-14:"Unassigned"
4:"IP Internet Protocol"
5:"ST ST Datagram Mode"
}}

field "Header Length" {
            len=4
            minValue=5
            desc="in 32 bit units"
            default=eval_fn(len, "IP", "IP Header", "/32")
}

field "Total Length" {
            minValue=20
            len=16
            desc="in octets include header length"
            default=eval_fn(len, "IP", "IP", "/8")
}
field "Header Checksum" {
            len=16
            default=eval_fn(checksum, "IP", "IP Header")
            display=hex
}
```

FIG. 8C

```
compound_field "Type Of Service" { // - - - - - - - -
        display=hex
        field "precedence" {
        len=3
        possible_values= {
0:"Routine"
1:"Priority"
2:"Immediate"
3:"Flash"
4:"Flash override"
5:"CRITIC/ECP"
6:"Internetwork Control"
7:"Network Control"
}}

field "Delay" {
len=1
        possible_values={0:"normal" 1:"low"}}

field "Throughput" {
        len=1
possible_values={0:"normal" 1:"high"}}

field "Reliability" {
        len=1
possible_values={0:"normal" 1:"high"}}

field "Monetary Cost" {
        len=1
possible_values={0:"normal" 1:"low"}}

field "Unused" {
        len=1
        possible_values={0:"valid"}}

}// end of field "Type of Service" - - - - - - - - - - -
```

FIG. 8D

```
compound_field "Flags" {
            len=3
            display=hex
field "Reserved" {
            len=1
            possible_values={0:"valid"}}
field "Fragment" {
            len=1
            possible_values={0:"May Fragment" 1:"Don't Fragment"}}
field "Fragments" {
            len=1
            possible_values={0:"last" 1:"more"}}
}
compound_field "Options" {// - - - - - - - - - - - - -
    optional = (valueof(field "Header Length") > 5)
    compound_field "Option Tuple"
{
len=8;
display=hex
field "Copied Flag" {
            len=1
            possible_values={0:"not copied into all fragments
          0:"not copied into all fragments on fragmentation"
    1:"copied into all fragments on fragmentation"
}}
field "Option Class" {
            len=2
            possible_values={
            0:"control"
     1:"reserved for future use"
            2."debugging and measurement"
            3:"reserved for future use"
}}
```

FIG. 8E

```
field "Option Number" {
        len=5
        field_type=mulopt_other_fld
        possible_values={
        0:"end of option list"
    1:"no operation"
        2:"security"
        3:"loose source routing"
    4:"internet timestamp"
        7:"record route"
    8:"stream ID"
        9:"strict source routing"
}}
}

switch(valueof(field "Option Number")){
  0:null
  1:null
  2:compound_field "Security"
  3:compound_field "Loose Source Routing"
  9:compound_field "Strict Source Routing"
  7:compound_field "Record Route"
  8:compound_field "Stream ID"
  4:compound_field "Internet Timestamp"
}

compound_field "Security"{
        len=80
        field "Security Length" {
            len=8
            possible_values={0x0b:"valid"}}
```

FIG. 8F

```
            field "Security: Security"
            field "Compartments" {len=16}
            field "Handling Restrictions" {len=16}
            field "Transmission Control Code" {len=24}

            field "Security Security" {
            len=16
            possible_values={
            0:"unclassified"
            0xf135:"confidential"
            0x0789a:"EFTO"
            0xbc4d:"MMMM"
            0x5e26:"PROG"
            0xaf13:"Restricted"
            0xd788:"Secret"
            0x6bc5:"Top Secret"
        0x35e2,0x9af1,0x4d78,0x24bd,0x135e,0x89af,0xc4d6,0xe26b:
            "Reserved for future use"
  }}
}

 compound_field "Strict Source Routing" {
  len=(valueof(field "Strict Source Routing Length")-1*8
  field "Strict Source Routing Length" {len=8 }
  field "Strict Source Routing Pointer" {len=8 minValue=4}

 repeat {
  len=(valueof(field "Strict Source Routing Length")-3)*8
  field "source address" {len=32 display=ipv4}
  }
}
```

FIG. 8G

```
compound_field "Loose Source Routing" {
  len=(valueof(field "Loose Source Routing Length")-1*8
  field "Loose Source Routing Length" {len=8 }
  field "Loose Source Routing Pointer" {len=8 minValue=4}
 repeat {
  len=(valueof(field "Loose Source Routing Length")-3)*8
  field "source address" {len=32 display=ipv4}
  }
}
 compound_field "Record Routing" {
  len=(valueof(field "Record Routing Length")-1)*8
  field "Record Routing Length" {len=8 }
  field "Record Routing Pointer" {len=8 minValue=4}
 repeat {
  len=(valueof(field "Record Routing Length")-3)*8
  field "source address" {len=32 display=ipv4}
  }
}
 compound_field "Stream ID" {
  len=24
  field "Stream ID Length" {
     len=8
                default=4
                possible_values=
                        0x04:"valid"
          }}
  field "ID" {len=16 default=4}
}
```

FIG. 8H

```
compound_field "Internet Timestamp" {
  field "Internet Timestamp Length" {len=8 }
  field "Internet Timestamp Pointer" {len=8 }
  field "Overflow" {
        len=4
   desc="number of iP modules that cannot register timestamps"
        }
  field "Flag" {
        len=4
        possible_values=1
   0:"time stamps only, stored in consecutive 32-bit words"
   1:"each timestamp is preceded with internet address"
   3:"the internet address fields are prespecified"
  }}

 } // end of Internet Timestamp
} // end of field "option" ----------

} // end of field "IP" ----------

field "Protocol" {

len=8
default=255
field_type = mulopt_prtcl_fld
display=hex
possible_values={ // ----------
   0:"HOPOPT (IPv6 Hop-by-Hop Option)"
   1:"ICMP (Internet Control Message)"
   2:"IGMP (Internet Group Management)"
   3:"GGP (Gateway-to-Gateway)"
```

FIG. 8I

4:"IP (IP in IP encapsulation)"
5:"ST (Stream)"
6:"TCP"
7:"CBT"
8:"EGP (Exterior Gateway Protocol)"
9:"IGP (any private interior gateway)"
10:"BBN-RCC-MON (BBN RCC Monitoring)"
11:"NVP-II (Network Voice Protocol)"
12:"PUP"
13:"ARGUS"
14:"EMCON"
15:"XNET (Cross Net Debugger)"
16:"CHAOS"
17:"UDP"
18:"MUX (Multiplexing)"
19:"DCN-MEAS (DCN Measurement Subsystems)"
20:"HMP (Host Monitoring)"
21:"PRM (Field Radio Measurement)"
22:"XNS-IDP (XEROX NS IDP)"
23:"TRUNK-1 (Trunk-1)"
24:"TRUNK-2 (Trunk-2)"
25:"LEAF-1 (Leaf-1)"
26:"LEAF-2 (Leaf-2)"
27:"RDP (Reliable Data Protocol)"
28:"IRTP (Internet Reliable Transaction)"
29:"ISO-TP4 (ISO Transport Protocol Class 4)"
30:"NETBLT (Bulk Data Transfer Protocol)"
31:"MFE-NSP (MFE Network Services Protocol)"
32:"MERIT-INP (MERIT Internodal Protocol)"
33:"SEP (Sequential Exchange Protocol)"
34:"3PC (Third Party Connect Protocol)"
35:"IDPR (Inter-Domain Policy Routing Protocol)"
36:"XTP (XTP)"

FIG. 8J

37:"DDP (Datagram Delivery Protocol)"
38:"IDPR-CMTP (IDPR Control Message Transport Protocol)"
39:"TP++ (TP++ Transport Protocol)"
40:"IL (IL Transport Protocol)"
41:"IPv6 (IPv6)"
42:"SDRP (Source Demand Routing Protocol)"
43:"IPv6-Route (Routing Header for IPv6)"
44:"IPv6-Frag (Fragment Header for IPv6)"
45:"IDRP (Inter-Domain Routing Protocol)"
46:"RSVP (Reservation Protocol)"
47:"GRE (General Routing Encapsulation)"
48:"MHRP (Mobile Host Routing Protocol)"
49:"BNA"
50:"ESP (Encap Security Payload for IPv6)"
51:"AH (Authentication Header for IPv6)"
52:"I-NLSP (Integrated Net Layer Security TUBA)"
53:"SWIPE (IP with Encryption)"
54:"NARP (NBMA Address Resolution Protocol)"
55:"MOBILE (IP Mobility)"
56:"TLSP (Transport Layer Security Protocol)"
57:"SKIP"
58:"IPv6-ICMP (ICMP for IPv6)"
59:"IPv6-NoNxt (No Next Header for IPv6)"
60:"IPv6-Opts (Destination Options for IPv6)"
61:"AHP (Any Host Internal Protocol)"
62:"CFTP (CFTP)"
63:"ALN (Any Local Network)"
64:"SAT-EXPAK (SATNET and Backroom EXPAK)"
65:"KRYPTOLAN (Kryptolan)"
66:"RVD (MIT Remote Virtual Disk Protocol)"
67:"IPPC (Internet Pluribus Field Core)"
68:"ADFS (Any Distributed File System)"
69:"SAT-MON (SATNET Monitoring)"
70:"VISA (VISA Protocol)"

FIG. 8K

71:"IPCV (Internet Field Core Utility)"
72:"CPNX (Computer Protocol Network Executive)"
73:"CPHB (Computer Protocol Heart Beat)"
74:"WSN (Wang Span Network)"
75:"PVP (Field Video Protocol)"
76:"BR-SAT-MON (Backroom SATNET Monitoring)"
77:"SUN-ND (SUN ND PROTOCOL-Temporary)"
78:"WB-MON (WIDEBAND Monitoring)"
79:"WB-EXPAK (WIDEBAND EXPAK)"
80:"ISO-IP (ISO Internet Protocol)"
81:"VMTP"
82:"SECURE-VMTP"
83:"VINES"
84:"TTP"
85:"NSFNET-IGP"
86:"DGP (Dissimilar Gateway Protocol)"
87:"TCF"
88:"EIGRP"
89:"OSPF"
90:"Sprite-RPC (Sprite RPC Protocol)"
91:"LARP (Locus Address Resolution Protocol)"
92:"MTP (Multicast Transport Protocol)"
93:"AX.25 (AX.25 Frames)"
94:"IPIP (IP-within-IP Encapsulation Protocol)"
95:"MICP (Mobile Internetworking Control Pro)"
96:"SCC-SP (Semaphore Communications Sec. Pro)"
97:"ETHERIP (Ethernet-within-IP Encapsulation)"
98:"ENCAP (Encapsulation Header)"
99:"APES (Any Private Encryption Scheme)"
100:"GMTP"
101:"IFMP (Ipsilon Flow Management Protocol)"
102:"PNNI (PNNI over IP)"
103:"PIM (Protocol Independent Multicast)"
104:"ARIS"

FIG. 8L

```
      105:"SCPS"
      106:"QNX"
      107:"A/N (Active Networks)"
      108:"IPPCP (IP Payload Compression Protocol)"
      109:"SNP (Sitara Networks Protocol)"
      110:"Compaq-Peer (Compaq Peer Protocol)"
      111:"IPX-in-IP"
      112:"VRRP (Virtual Router Redundancy Protocol)"
      113:"PGM (PGM Reliable Transport Protocol)"
      114:"AHOP (Any 0-hop protocol)"
      115-254:"Unassigned"
      255:"Reserved"
  }} // end of field "protocol" ----------------

      } // end of field "IP header" ------------

836
  payload "IP Payload" {// ----------------
      switch(valueof(field "Protocol")) {
838       1:protocol "ICMP"
      2:protocol "IGMP"
      6:protocol "TCP"
      17:protocol "UDP"
      46:protocol "RSVP"
      47:protocol "GRE"
      89.protocol "OSPF"
      }
  } // end of packet "IP payload" ------------
}
```

FIG. 9A

```
*/
/*****************************************************************************
Constants
***************************************************************************** /
//======== LCP Options ==================================
int OPT_PASSIVE  = 1;    // Don't die if we don't get a response
int OPT_RESTART = 2;     // Treat 2nd OPEN as DOWN, UP
int OPT_SILENT = 4;      // Wait for peer to speak first

//======== LCP States    ==================================
int INITIAL_STATE = 0;
int STARTING_STATE = 1;
int CLOSED_STATE = 2;
int STOPPED_STATE = 3;
int CLOSING_STATE = 4;
int STOPPING_STATE = 5;
int REQ_SENT_STATE = 6;
int ACK_RCVD_STATE = 7;
int ACK_SENT_STATE = 8;
int OPENED_STATE = 9;

//======== LCP Events    ==================================
int UP_EVENT = 0;
int DOWN_EVENT = 1;
int OPEN_EVENT = 2;
int CLOSE_EVENT = 3;
int TIMEOUT_POS_EVENT = 4;
```

FIG. 9B

```
int  TIMEOUT_NEG_EVENT = 5;
int  RCV_CFG_REQ_POS_EVENT = 6;
int  RCV_CFG_REQ_NEG_EVENT = 7;
int  RCV_CFG_ACK_EVENT = 8;
int  RCV_CFG_NACK_EVENT = 9;
int  RCV_TERM_REQ_EVENT = 10;
int  RCV_TERM_ACK_EVENT = 11;
int  RCV_UNKN_CODE_EVENT = 12;
int  RCV_CODE_REJECT_POS_EVENT = 13;
int  RCV_CODE_REJECT_NEG_EVENT = 14;
int  RCV_ECHO_REQ_REPLY_EVENT = 15;

//======== Transition Constants  ============================
int  TRANSITION_CNST_FALSE = 0:
int  TRANSITION_CNST_TRUE = 1:

902 —fsm   "LCP"
    {
904 —state  INITIAL_STATE                              924
                                                        ↙
926 {
    —UP_EVENT   -                          CLOSED_STATE
928 —OPEN_EVENT InitialStOpenEvent         STARTING_STATE

    } // INITIAL
```

FIG. 9C

906

```
state STARTING_STATE
{
UP_EVENT
\
        switch (enabledSilent())
\
            TRANSITION_CNST_TRUE:   StareingStUpEvEnabledSilentTrue
STOPPED_STATE
            TRANSITION_CNST_FALSE:  StareingStUpEvEnabledSilentFalse
REQ_SENT_STATE
        }
\
CLOSE_EVENT     -
} / / STARTING
```

908

```
state CLOSED_STATE
{
DOWN_EVENT                                              INITIAL_STATE
\
        switch (enabledSilent())
\
```

```
    {
\
        TRANSITION_CNST_TRUE:       ClosedStOpenEvEnabledSilentTRUE
STOPPED_STATE   \
        TRANSITION_CNST_FALSE:      ClosedStOpenEvEnabledSilentFALSE
REQ_SENT_STATE  \
    }
\
RCV_CFG_REQ_POS_EVENT       ClosedStRcvCfgReqPosEv          CLOSED_STATE
RCV_CFG_REQ_NEG_EVENT       ClosedStRcvCfgReqNegEv          CLOSED_STATE
RCV_CFG_ACK_EVENT           ClosedStRcvCfgAckEv             CLOSED_STATE
RCV_CFG_NACK_EVENT          ClosedStRcvCfgNackEv            CLOSED_STATE
RCV_CODE_REJECT_POS_EVENT   RcvCodeRejectPosEv              CLOSED_STATE
RCV_CODE_REJECT_NEG_EVENT   ClosedStRcvCodeRejectNegEv      CLOSED_STATE
RCV_ECHO_REQ_REPLY_EVENT    RcvEchoReqReplyEv               CLOSED_STATE

} // CLOSED
910
state STOPPED_STATE
{
DOWN_EVENT                  StoppedStDownEv                 STARTING_STATE
OPEN_EVENT
\
        switch(enabledRestart ())
\
    {
\
        TRANSITION_CNST_TRUE:   StoppedStOpenEvEnabledRestartTRUE   STOPPED_STATE
\
```

FIG. 9D

FIG. 9E

```
    }

\
CLOSE_EVENT                     -                              CLOSED_STATE
RCV_CFG_REQ_POS_EVENT           StoppedStRcvCfgReqPosEv        ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT           StoppedStRcvCfgReqNegEv        REQ_SENT_STATE
RCV_CFG_ACK_EVENT               StoppedStRcvCfgAckEv           STOPPED_STATE
RCV_CFG_NACK_EVENT              StoppedStRcvCfgNackEv          STOPPED_STATE
RCV_CODE_REJECT_POS_EVENT       RcvCodeRejectPosEv             STOPPED_STATE
RCV_CODE_REJECT_NEG_EVENT       StoppedStRcvCodeRejectNegEv    STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT        RcvEchoReqReplyEv              STOPPED_STATE

} // STOPPED
912
state CLOSING_STATE
{
DOWN_EVENT                      ClosingStDownEv                INITIAL_STATE
OPEN_EVENT                      ClosingStOpenEv                STOPPING_STATE
TIMEOUT_POS_EVENT               ClosingStTimeoutPosEv          CLOSING_STATE
TIMEOUT_NEG_EVENT               ClosingStTimeNegEv             CLOSED_STATE
RCV_TERM_ACK_EVENT              ClosingStRcvTermAckEv          CLOSED_STATE
RCV_CODE_REJECT_POS_EVENT       RcvCodeRejectPosEv             CLOSING_STATE
RCV_CODE_REJECT_NEG_EVENT       RcvCodeRejectNegEv             CLOSED_STATE
RCV_ECHO_REQ_REPLY_EVENT        RcvEchoReqReplyEv              CLOSING_STATE

} // CLOSING
```

FIG. 9F

914 state STOPPING_STATE

{

DOWN_EVENT	StoppingStDownEv	STARTING_STATE
CLOSE_EVENT	-	CLOSING_STATE
TIMEOUT_POS_EVENT	StoppingStTimeoutPosEv	STOPPING_STATE
TIMEOUT_NEG_EVENT	StoppingStTimeNegEv	STOPPED_STATE
RCV_TERM_ACK_EVENT	StoppingStRcvTermAckEv	STOPPED_STATE
RCV_CODE_REJECT_POS_EVENT	RcvCodeRejectPosEv	STOPPING_STATE
RCV_CODE_REJECT_NEG_EVENT	RcvCodeRejectNegEv	STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT	RcvEchoReqReplyEv	STOPPING_STATE

} // STOPPING

916 state REQ_SENT_STATE

{

DOWN_EVENT	ReqSentStDownEv	STARTING_STATE
CLOSE_EVENT	ReqSentStCloseEv	CLOSING_STATE
TIMEOUT_POS_EVENT	ReqSentStTimeoutPosEv	REQ_SENT_STATE
TIMEOUT_NEG_EVENT	ReqSentStTimeNegEv	STOPPED_STATE
RCV_CFG_REQ_POS_EVENT	ReqSentStRcvCfgReqPosEv	ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT	ReqSentStRcvCfgReqNegEv	REQ_SENT_STATE
RCV_CFG_ACK_EVENT	ReqSentStRcvCfgAckEv	ACK_RCVD_STATE
RCV_CFG_NACK_EVENT	ReqSentStRcvCfgNackEv	REQ_SENT_STATE
RCV_CODE_REJECT_POS_EVENT	RcvCodeRejectPosEv	REQ_SENT_STATE
RCV_CODE_REJECT_NEG_EVENT	RcvCodeRejectNegEv	STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT	RcvEchoReqReplyEv	REQ_SENT_STATE

} // REQ_SENT_STATE

FIG. 9G

```
918
state ACK_RCVD_STATE
{
DOWN_EVENT                  AckRcvdStDownEv          STARTING_STATE
CLOSE_EVENT                 AckRcvdStCloseEv         CLOSING_STATE
TIMEOUT_POS_EVENT           AckRcvdStTimeoutPosEv    REQ_SENT_STATE
TIMEOUT_NEG_EVENT           AckRcvdStTimeNegEv       STOPPED_STATE
RCV_CFG_REQ_POS_EVENT       AckRcvdStRcvCfgReqPosEv  OPENED_STATE
RCV_CFG_REQ_NEG_EVENT       AckRcvdStRcvCfgReqNegEv  ACK_RCVD_STATE
RCV_CFG_ACK_EVENT           AckRcvdStRcvCfgAckEv     REQ_SENT_STATE
RCV_CFG_NACK_EVENT          AckRcvdStRcvCfgNackEv    REQ_SENT_STATE
RCV_TERM_REQ_EVENT          AckRcvdStRcvTermReqEv    REQ_SENT_STATE
RCV_TERM_ACK_EVENT          -                        REQ_SENT_STATE
RCV_UNKN_CODE_EVENT         -                        ACK_RCVD_STATE
RCV_CODE_REJECT_POS_EVENT   RcvCodeRejectPosEv       REQ_SENT_STATE
RCV_CODE_REJECT_NEG_EVENT   RcvCodeRejectNegEv       STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT    RcvEchoReqReplyEv        ACK_RCVD_STATE

} // ACK_RCVD_STATE

920
state ACK_SENT_STATE
{
DOWN_EVENT                  AckSentStDownEv          STARTING_STATE
CLOSE_EVENT                 AckSentStCloseEv         CLOSING_STATE
TIMEOUT_POS_EVENT           AckSentStTimeoutPosEv    ACK_SENT_STATE
TIMEOUT_NEG_EVENT           AckSentStTimeNegEv       STOPPED_STATE
```

FIG. 9H

```
RCV_CFG_REQ_POS_EVENT          AckSentStRcvCfgReqPosEv          ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT          AckSentStRcvCfgReqNegEv          REQ_SENT_STATE
RCV_CFG_ACK_EVENT              AckSentStRcvCfgAckEv             OPENED_STATE
RCV_CFG_NACK_EVENT             AckSentStRcvCfgNackEv            ACK_SENT_STATE
RCV_TERM_REQ_EVENT             AckSentStRcvTermReqEv            REQ_SENT_STATE
RCV_CODE_REJECT_POS_EVENT      RcvCodeRejectPosEv               ACK_SENT_STATE
RCV_CODE_REJECT_NEG_EVENT      RcvCodeRejectNegEv               STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT       RcvEchoReqReplyEv                ACK_SENT_STATE

} // ACK_SENT_STATE

922
state OPENED_STATE
{
DOWN_EVENT                     OpenedStDownEv                   STARTING_STATE
OPEN_EVENT
\
        switch(enabledRestart ())
\
    {
\
        TRANSITION_CNST_TRUE:  OpenedStOpenEvEnabledRestartTRUE  OPENED_STATE
\
    }
\
```

FIG. 9I

CLOSE_EVENT	OpenedStCloseEv	CLOSING_STATE
RCV_CFG_REQ_POS_EVENT	OpenedStCfgReqPosEv	ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT	OpenedStRcvCfgReqNegEv	REQ_SENT_STATE
RCV_CFG_ACK_EVENT	OpenedRcvCfgAckEv	REQ_SENT_STATE
RCV_CFG_NACK_EVENT	OpenedStRcvCfgNackEv	REQ_SENT_STATE
RCV_TERM_REQ_EVENT	OpenedStRcvTermReqEv	STOPPING_STATE
RCV_TERM_ACK_EVENT	OpenedStRcvTermAckEv	REQ_SENT_STATE
RCV_CODE_REJECT_POS_EVENT	RcvCodeRejectPosEv	OPENED_STATE
RCV_CODE_REJECT_NEG_EVENT	OpenedStRcvCodeRejectNegEv	STOPPING_STATE
RCV_ECHO_REQ_REPLY_EVENT	RcvEchoReqReplyEv	OPENED_STATE

} // OPENED_STATE

}

FIG. 10

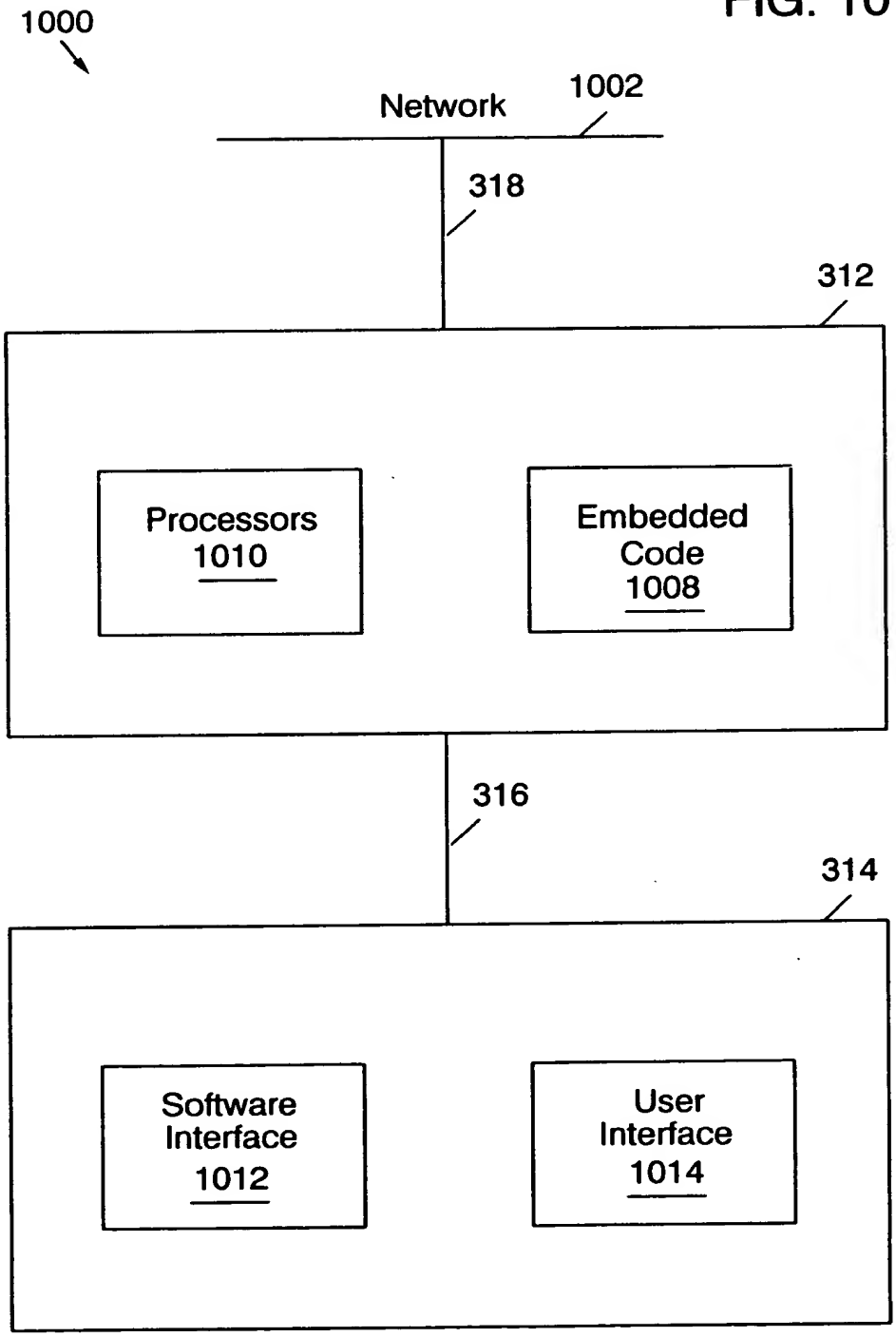

1000
Network
1002
318
312
Processors
1010
Embedded
Code
1008
316
314
Software
Interface
1012
User
Interface
1014

FIG. 11

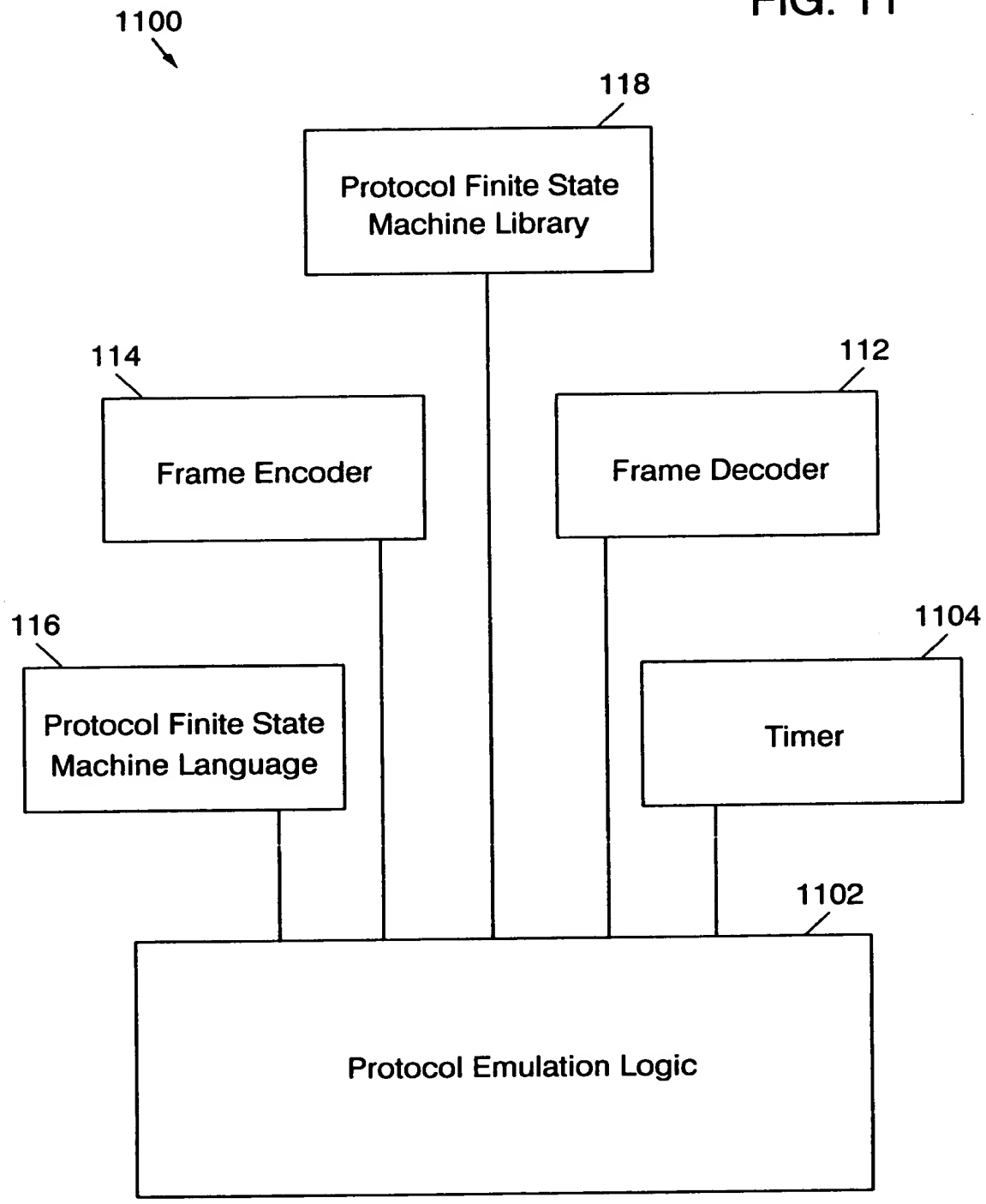

1100
118
Protocol Finite State Machine Library
114
Frame Encoder
112
Frame Decoder
116
Protocol Finite State Machine Language
1104
Timer
1102
Protocol Emulation Logic

FIG. 12A

1202

Events	State 0 Initial	1 Starting	2 Closed	3 Stopped	4 Closing	5 Stopping
Up	2	tc1,6	-	-	-	-
Down	-	-	0	1	0	1
Open	1	1	tc1,3/tc2,6	tc3,3r	5r	5r
Close	0	0	2	2	4	4
TO+	-	-	-	-	4	5
TO-	-	-	-	-	2	3
RCR+	-	-	2	8	4	5
RCR-	-	-	2	6	4	5
RCA	-	-	2	3	4	5
RCN	-	-	2	3	4	5
RTR	-	-	2	3	4	5
RTA	-	-	2	3	2	3
RUC	-	-	2	3	4	5
RXJ+	-	-	2	3	4	5
RXJ-	-	-	2	3	2	3
RXR	-	-	2	3	4	5

FIG. 12B

1204

Events	State 6 Req-Sent	7 Ack-Rcvd	8 Ack-Sent	9 Opened
Up	-	-	-	-
Down	1	1	1	1
Open	6	7	8	tc3,9r
Close	4	4	4	4
TO+	6	6	8	-
TO-	3p	3p	3p	-
RCR+	8	9	8	8
RCR-	6	7	6	6
RCA	7	6	9	6
RCN	6	6	8	6
RTR	6	6	6	5
RTA	6	6	8	6
RUC	6	7	8	9
RXJ+	6	6	8	9
RXJ-	3	3	3	5
RXR	6	7	8	9

[p] Passive option
[r] Restart option
[s] Silent option

// Transition conditions
tc1 - (enabledSilent() == TRUE)
tc2 - (enabledSilent() == FALSE)
tc3 - (enabledRestart() == TRUE)

FIG. 13

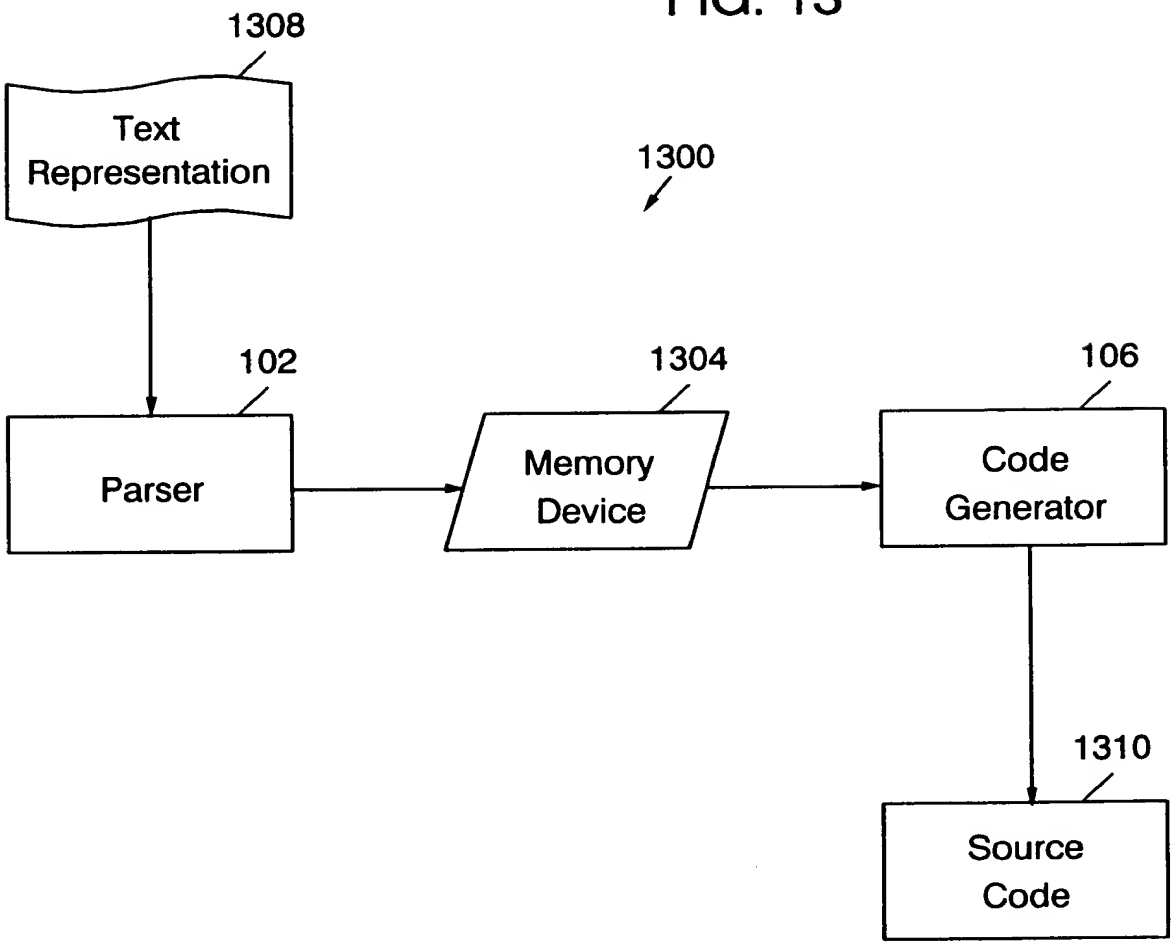

1308
Text Representation
1300
102
Parser
1304
Memory Device
106
Code Generator
1310
Source Code

FIG. 14

FIG. 14A	FIG. 14B

FIG. 14A

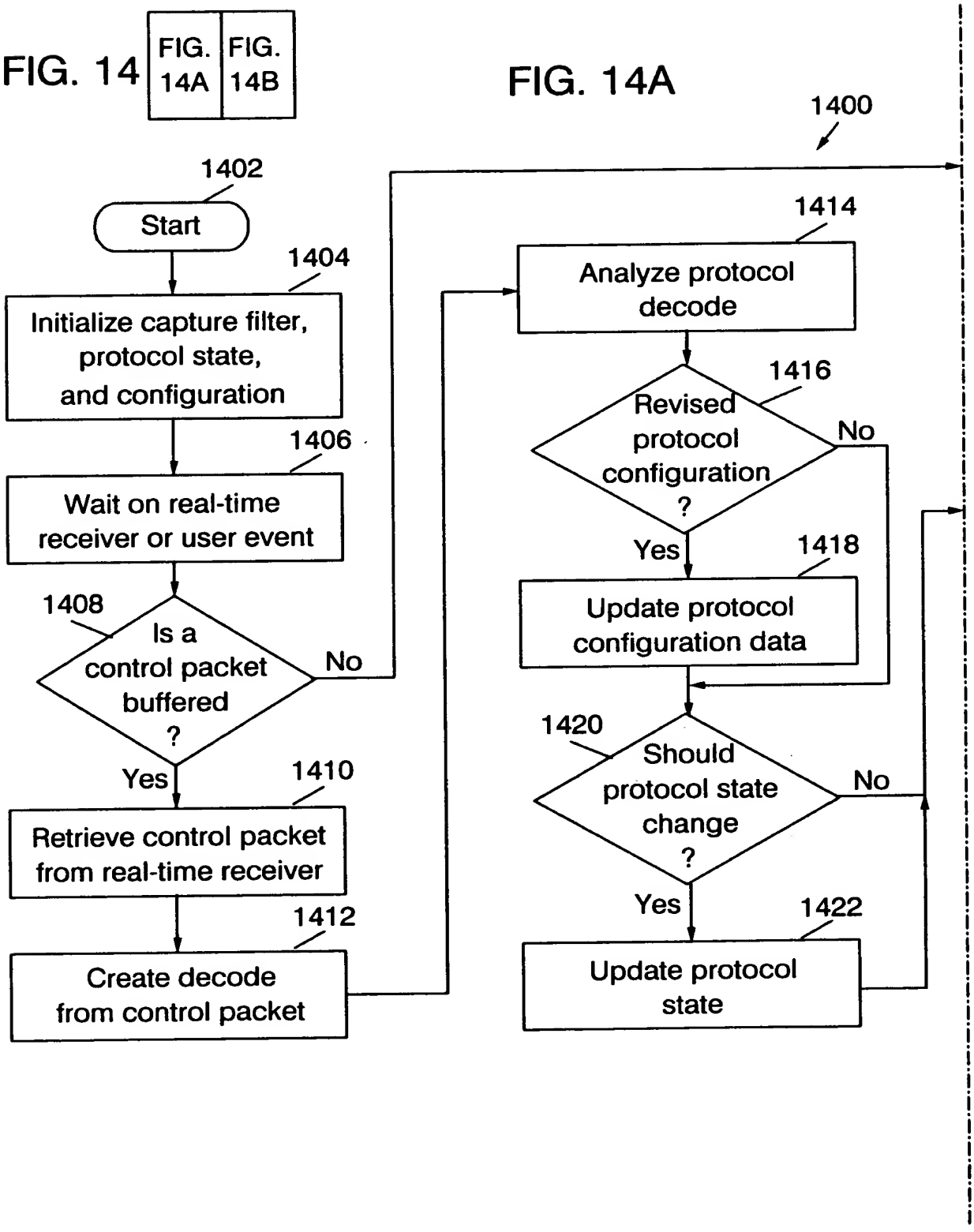


FIG. 14B

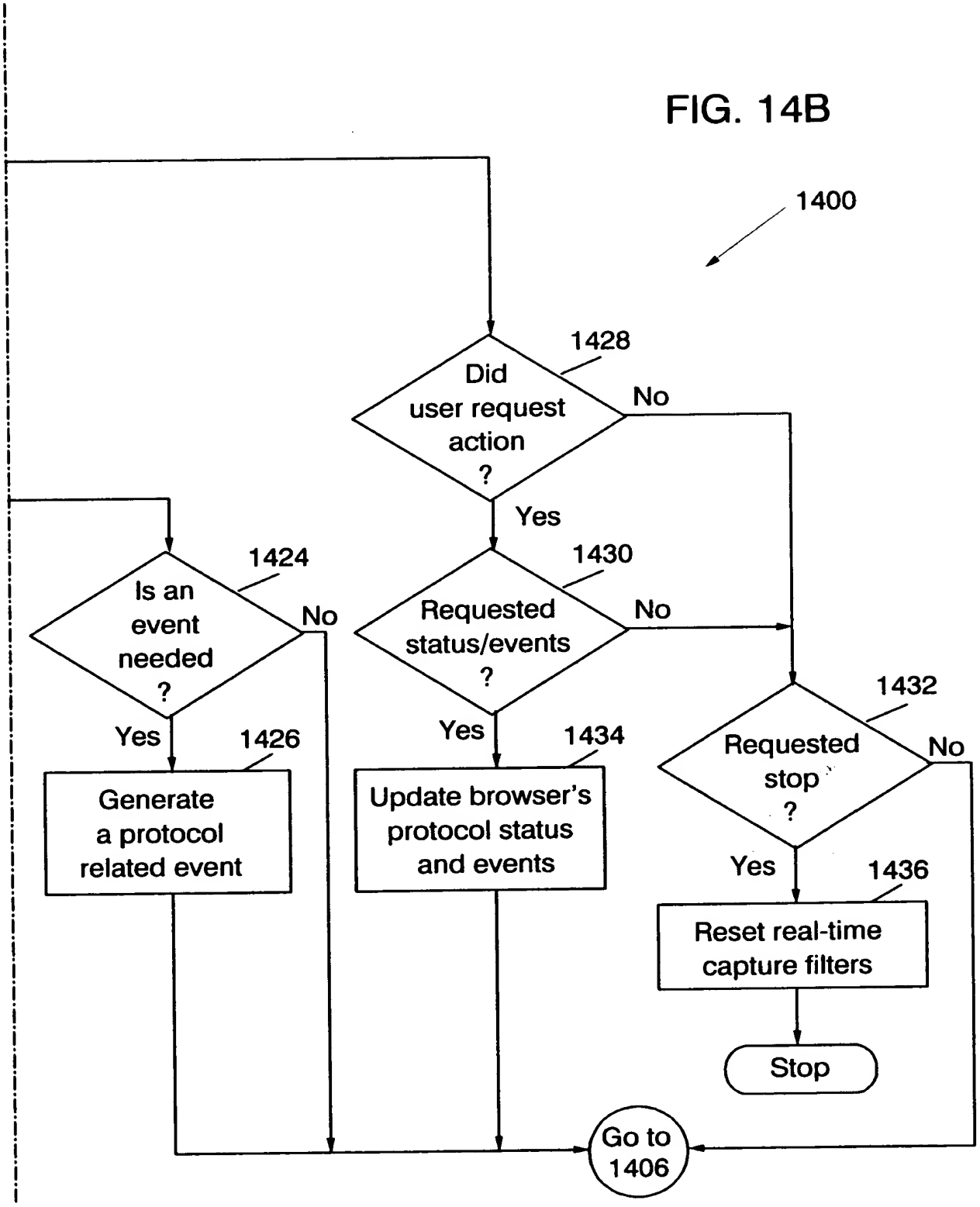

1400
1428
Did user request action ?
No
Yes
1424
Is an event needed ?
No
Yes
1426
Generate a protocol related event
1430
Requested status/events ?
No
Yes
1434
Update browser's protocol status and events
1432
Requested stop ?
No
Yes
1436
Reset real-time capture filters
Stop
Go to 1406

FIG. 15

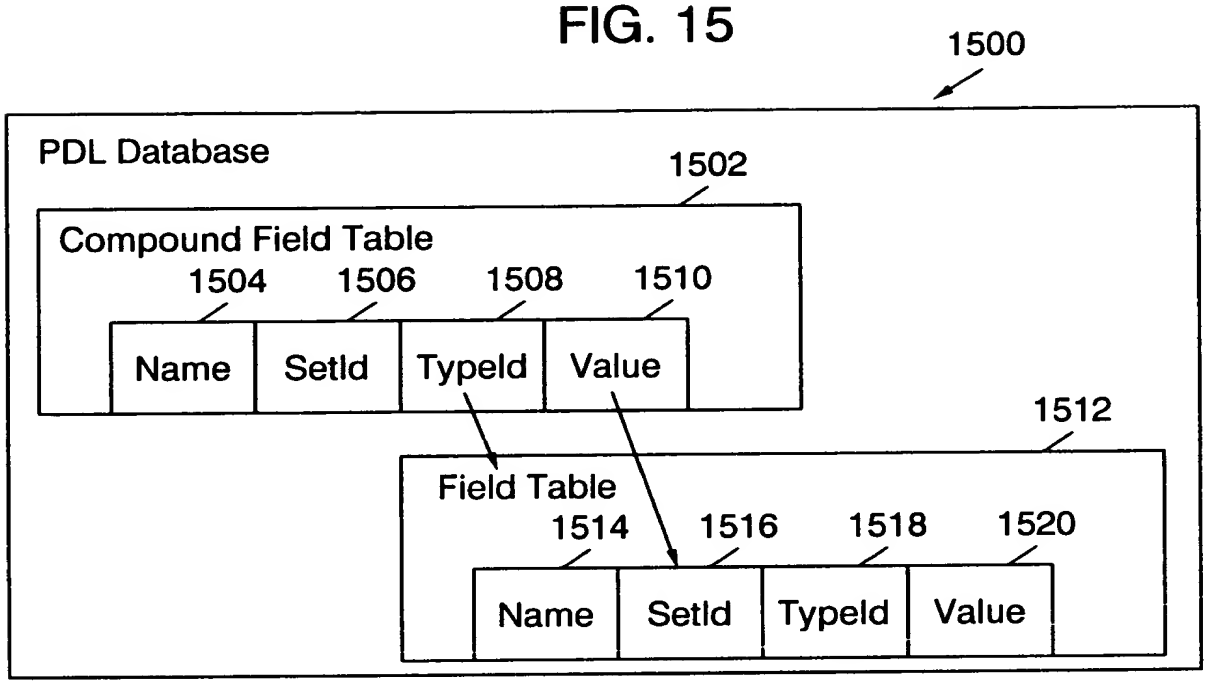

1500
PDL Database
1502
Compound Field Table
1504
1506
1508
1510
Name
SetId
TypeId
Value
1512
Field Table
1514
1516
1518
1520
Name
SetId
TypeId
Value

FIG. 18

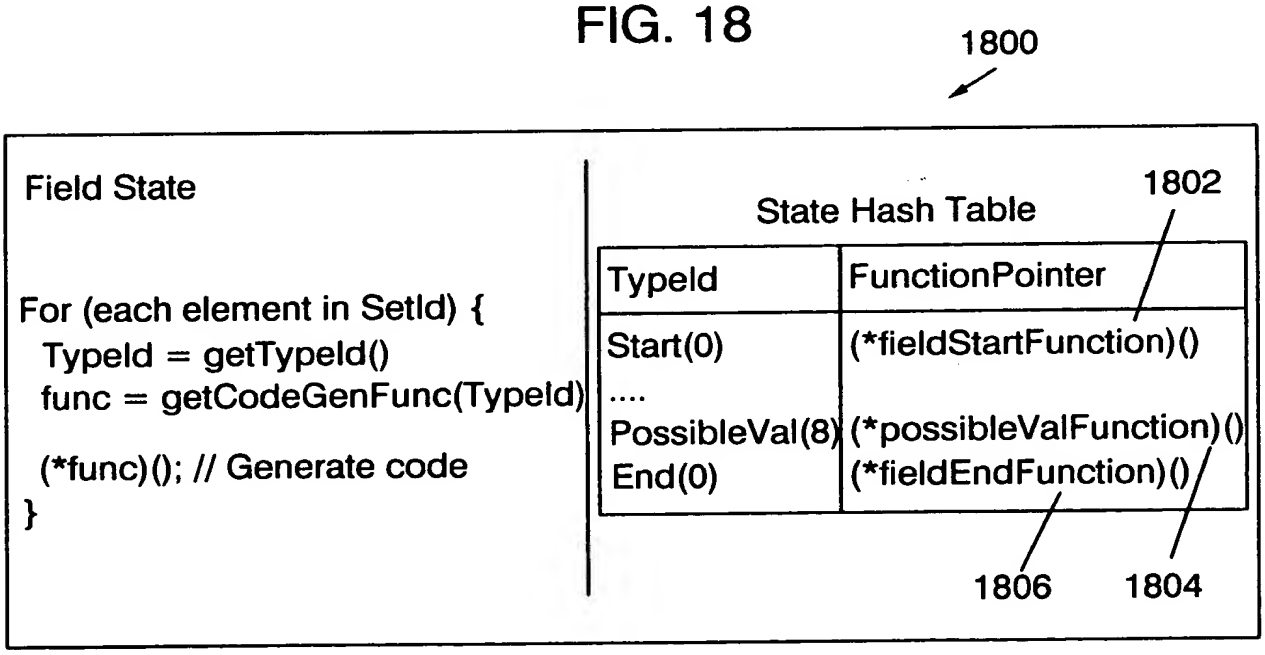

1800
Field State
For (each element in SetId) {
TypeId = getTypeId()
func = getCodeGenFunc(TypeId)
(*func)(); // Generate code
}
State Hash Table
1802
TypeId
FunctionPointer
Start(0)
(*fieldStartFunction)()
....
PossibleVal(8)
(*possibleValFunction)()
End(0)
(*fieldEndFunction)()
1806
1804

FIG. 16

1600

1610 TypeId	TypeName	TableName	Type	Comment
0	Start		Control	
0	ProtocolNames	ProtocolNames		
1	Protocol	Protocol	Compound	
2	Header	Header	Compound	
3	Payload	Payload	Compound	
4	Trailer	Trailer	Compound	
5	CompountField	CompountField	Compound	
6	Repeat	Repeat	Compound	
7	Switch	Switch	Compound	
8	PossibleValues	PossibleValues	Attribute	
9	Field	Field	Simple	
10	Len	Len	Attribute	
11	MinLen	Len	Attribute	
12	MaxLen	Len	Attribute	
13	Display	Display	Attribute	
14	Encode	Encode	Attribute	
15	Default	Default	Attribute	
16	Break	Len	Attribute	
17	Optional	Len	Attribute	
18	Offset	Len	Attribute	
19	Name	Name	Attribute	
20	Description	Description	Attribute	
1612 21	String	String		
22	End	End	Control	
23	DecisiveField	Field	Simple	
24	FieldType	Attribute	Attribute	
28	MinVal	Attribute	Attribute	
29	MaxVal	Attribute	Attribute	
30	Count	Len	Attribute	

1602 1604 1606 1608

FIG. 17

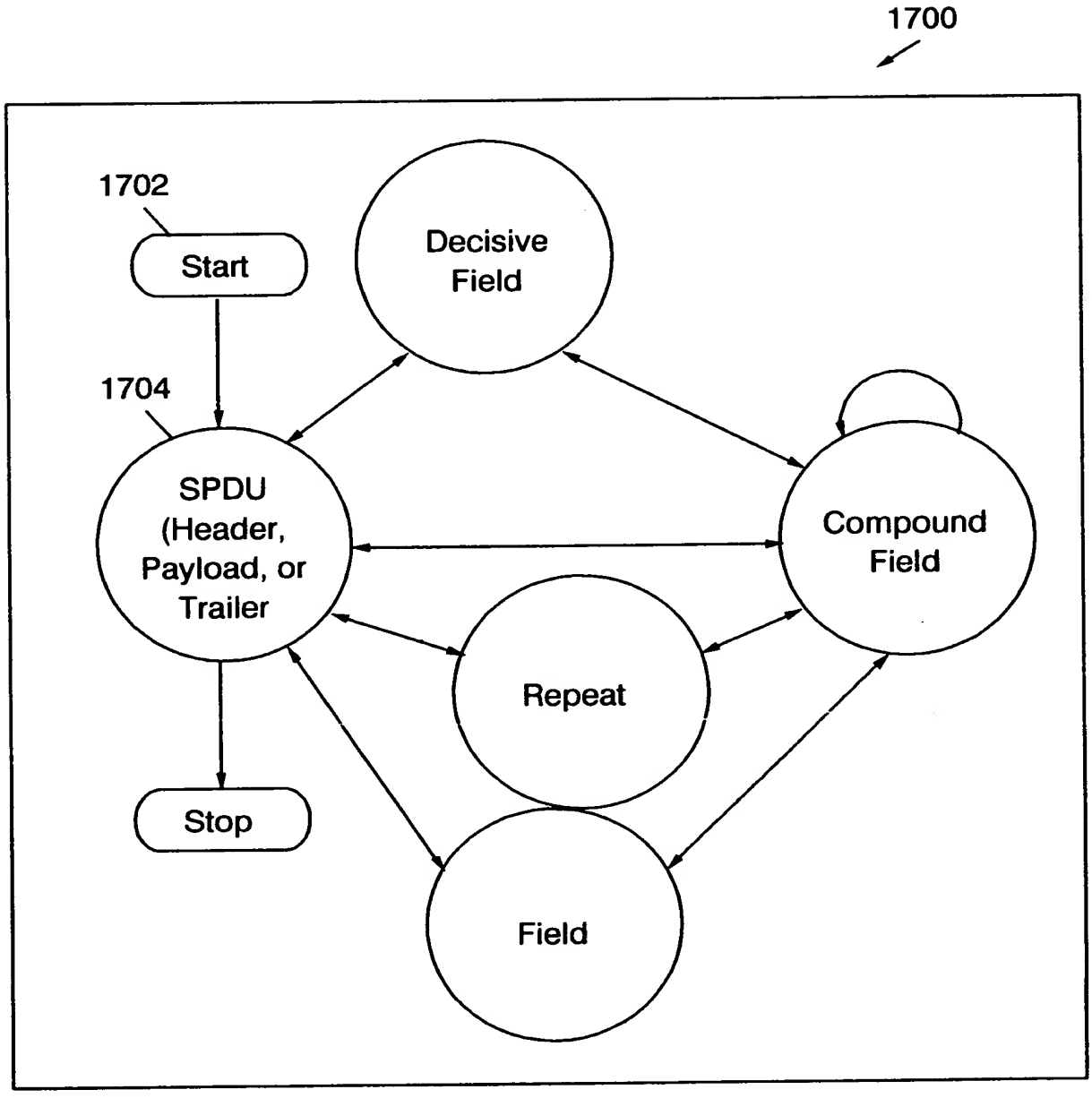
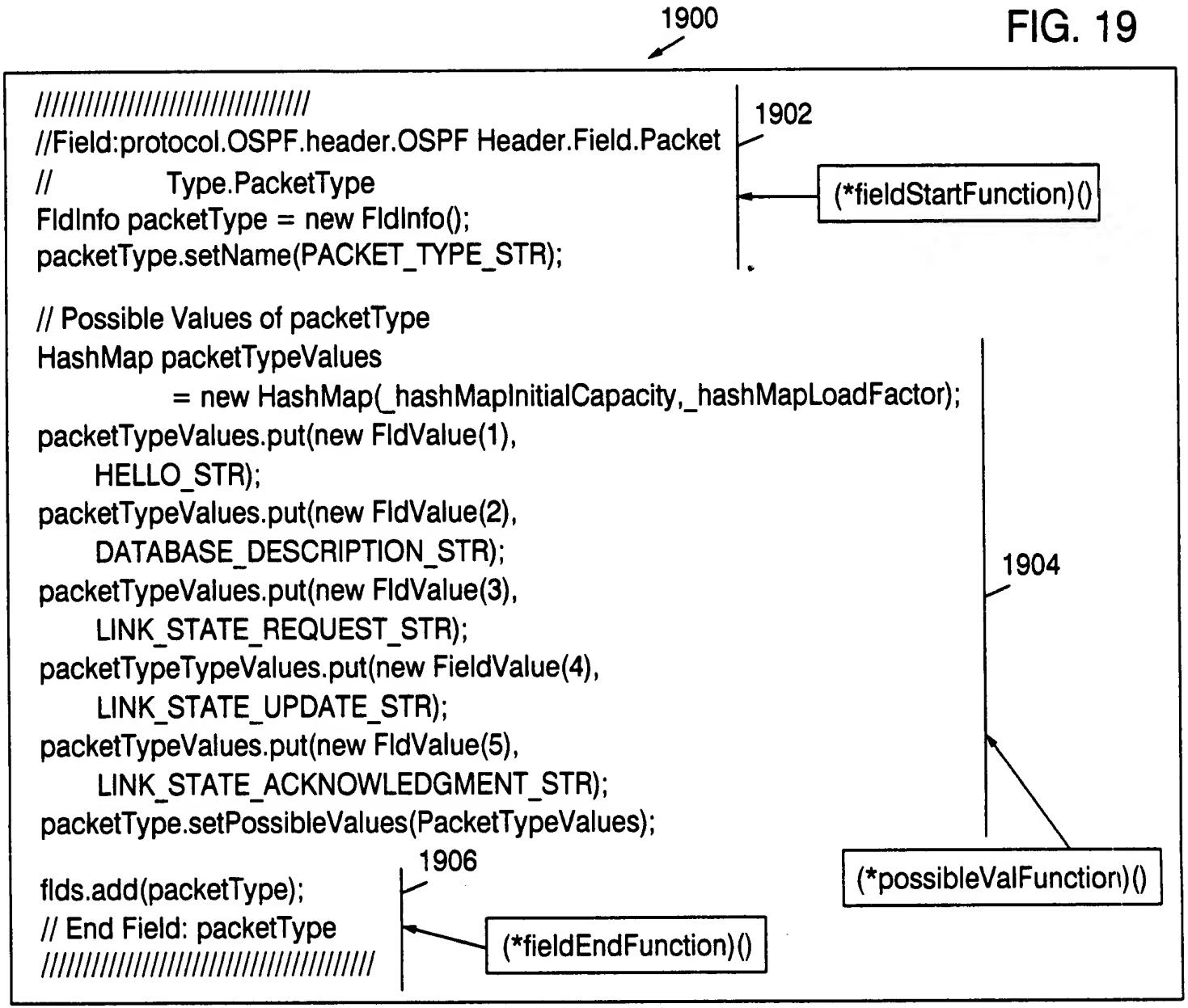

1700
1702
Start
1704
SPDU
(Header,
Payload, or
Trailer
Stop
Decisive
Field
Compound
Field
Repeat
Field

FIG. 19




```
////////////////////////////////
//Field:protocol.OSPF.header.OSPF Header.Field.Packet
//            Type.PacketType
FldInfo packetType = new FldInfo();
packetType.setName(PACKET_TYPE_STR);

// Possible Values of packetType
HashMap packetTypeValues
            = new HashMap(_hashMapInitialCapacity,_hashMapLoadFactor);
packetTypeValues.put(new FldValue(1),
      HELLO_STR);
packetTypeValues.put(new FldValue(2),
      DATABASE_DESCRIPTION_STR);
packetTypeValues.put(new FldValue(3),
      LINK_STATE_REQUEST_STR);
packetTypeTypeValues.put(new FieldValue(4),
      LINK_STATE_UPDATE_STR);
packetTypeValues.put(new FldValue(5),
      LINK_STATE_ACKNOWLEDGMENT_STR);
packetType.setPossibleValues(PacketTypeValues);

flds.add(packetType);
// End Field: packetType
////////////////////////////////////
```

FIG. 20

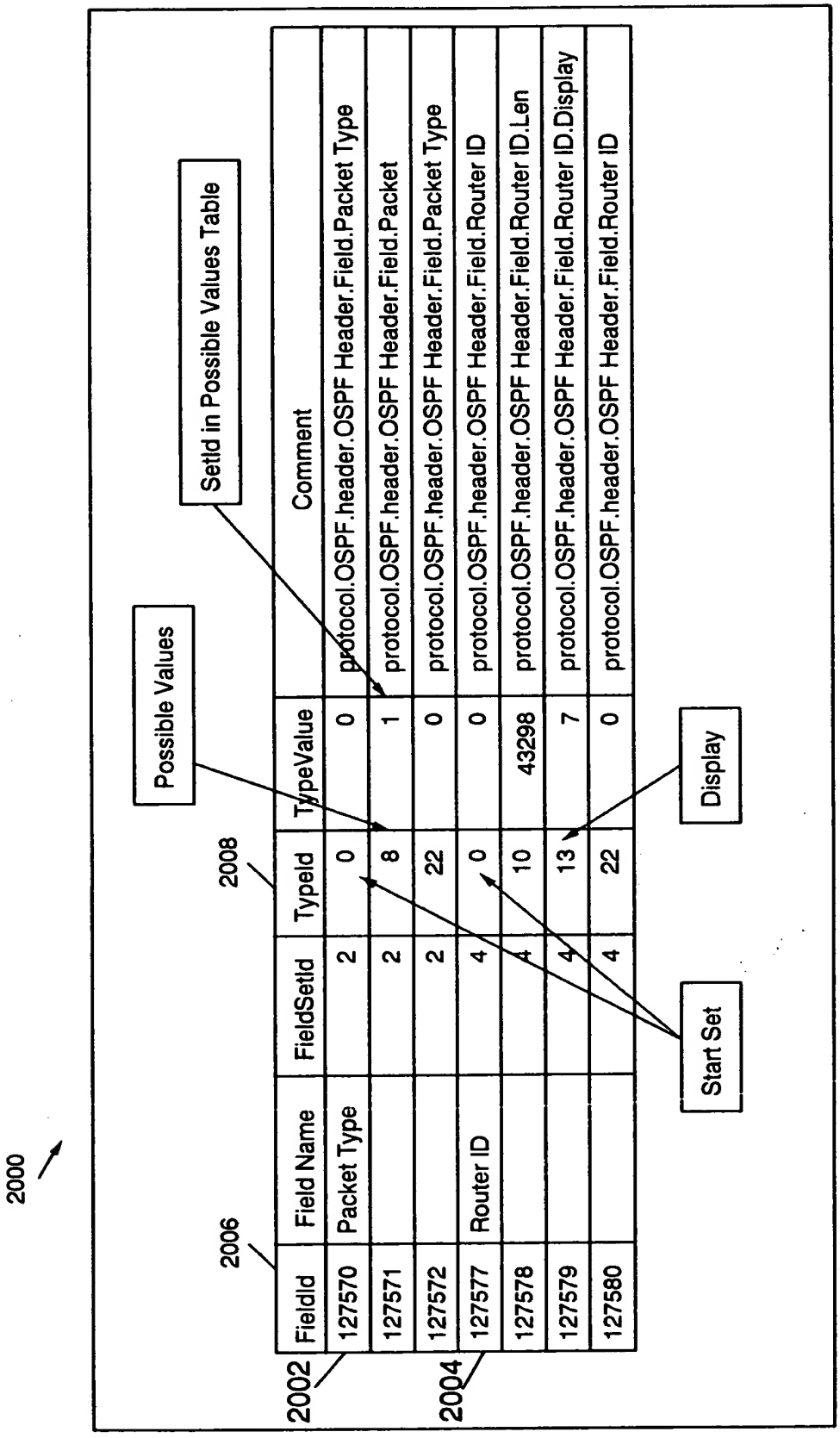

2000
2002
2004
2006
2008
FieldId
Field Name
FieldSetId
TypeId
TypeValue
Comment
127570
Packet Type
2
0
0
protocol.OSPF.header.OSPF Header.Field.Packet Type
127571
2
8
1
protocol.OSPF.header.OSPF Header.Field.Packet
127572
2
22
0
protocol.OSPF.header.OSPF Header.Field.Packet Type
127577
Router ID
4
0
0
protocol.OSPF.header.OSPF Header.Field.Router ID
127578
4
10
43298
protocol.OSPF.header.OSPF Header.Field.Router ID.Len
127579
4
13
7
protocol.OSPF.header.OSPF Header.Field.Router ID.Display
127580
4
22
0
protocol.OSPF.header.OSPF Header.Field.Router ID
Possible Values
SetId in Possible Values Table
Start Set
Display

FIG. 21

Protocol	Status	Time	Mode
LCP	Open	09/04/00 08:01:03 AM	Emulate
IPCP	Negotiating	09/04/00 08:01:07 AM	Monitor
MPLSCP	Closed	09/04/00 08:01:05 AM	Monitor
RSVP	N/a	09/04/00 08:01:00 AM	Disabled

FIG. 22

	Rx1	Rx2
Current Status	Open	Negotiating
Loop-back	No	No
Unanswered Echo Requests	0	0
Maximum Receive Unit	512	1500
Asynchronous Character Map	0	0
Authentication Protocol	Unknown	Unknown
Quality Protocol	N/a	N/a
Protocol Field Compression	Off	Off
Address/Control Field Compression	Off	Off
Magic Number	0xFF	0x1FF
FCS Alternative	CCITT 32-bit	CCITT 32-bit

FIG. 23

FIG. 23A

FIG. 23B

FIG. 23A

Time	Recvr	Protocol	MsgType	Event	Synopsis
09/04/00 08:01:01 AM	Rx1	LCP	ConfigReq	Protocol Negotiating	ACComp:On,Pcomp:On,Magic.0x1ab82049
09/04/00 08:01:01 AM	Rx2	LCP	ConfigAck	Open Protocol	ACComp:On,Pcomp:On,Magic.0x4e3d9123
09/04/00 08:01:02 AM	Rx2	LCP	ConfigReq	Protocol Negotiating	ACComp:On,Pcomp:On,Magic.0x1ab82049
09/04/00 08:01:03 AM	Rx1	LCP	ConfigAck	Open Protocol	ACComp:On,Pcomp:On,Magic.0x1ab82049
09/04/00 08:01:04 AM	Rx2	IPCP	ConfigReq	Protocol Negotiating	Local IP: 198.85.38.199
09/04/00 08:01:06 AM	Rx1	IPCP	ConfigAck	Open Protocol	Local IP: 198.85.38.199
09/04/00 08:01:06 AM	Rx1	IPCP	ConfigReq	Protocol Negotiating	Local IP: 198.85.34.35
09/04/00 08:01:06 AM	Rx2	IPCP	ConfigAck	Open Protocol	Local IP: 198.85.34.35
09/04/00 08:01:10 AM	Rx2	MPLSCP	ConfigReq	Protocol Negotiating	
09/04/00 08:01:12 AM	Rx2	MPLSCP	TermReq	Close Protocol	
09/04/00 08:11:01 AM	Rx1	RSVP	Rx1	Rx1	Resv Request <session: 198.85.34.45 UDP port 14>

09/04/00 08:11:03 AM	Rx1	RSVP	Rx1	Rx1	Resv Confirm <session: 198.85.34.45 UDP port 14>
09/04/00 08:11:04 AM	Rx2	RSVP	Rx2	Rx2	Path Request <session: 198.85.38.199 UDD port 0x82A>
09/04/00 08:11:06 AM	Rx1	RSVP	Rx1	Rx1	Resv Error <session: 198.85.38.199 UDP port 0x82A>
09/04/00 09:21:10 AM	Rx2	RSVP	Rx2	Rx2	Path Request <session: 198.85.38.199 UDP port 0x82A>
09/04/00 09:21:12 AM	Rx2	RSVP	Rx2	Rx2	Resv Confirm <session: 198.85.38.199 UPD port 0x82A>
09/04/00 09:21:30 AM	Rx1	RSVP	Rx1	Rx1	Path Tear <session: 198.85.34.45 UPD port 14>
09/04/00 09:21:32 AM	Rx2	RSVP	Rx2	Rx2	Resv Tear <session: 198.85.34.45 UPD port 14>
09/04/00 09:21:32 AM	Rx2	RSVP	Rx2	Rx2	Resv Tear <session: 198.85.34.45 UPD port 14>
09/04/00 11:44:30 PM	Rx1	IPCP	TermReq	Close Protocol	
09/04/00 11:44:31 PM	Rx1	IPCP	TermAck	Close Protocol	
09/04/00 11::44:32 PM	Rx1	LCP	TermReq	Close Protocol	
09/04/00 11:44:33 PM	Rx2	LCP	TermAck	Close Protocol	

FIG. 23B